THE STANDARDS AND WORK OF THE PHILADELPHIA PEDIATRIC SOCIETY'S MILK COMMISSION.

EMBODYING A REPLY TO A CRITICISM BY DR. A. H. STEWART, OF THE PHILADELPHIA BUREAU OF HEALTH.[1]

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The Milk Commission of the Philadelphia Pediatric Society was appointed in January, 1899. A close relationship between the milk supply and the high infant mortality, especially in the summer months, had been recognized for many years. Many efforts had been made to improve the conditions governing milk production. Pasteurization and sterilization had been resorted to, the various proprietory foods had been extensively used, and all without any material influence upon the death rate.

It was thought by the Pediatric Society that something might be accomplished in this line by interesting some of the modern well-equipped dairies in the production of a milk of a high degree of cleanliness, with a low bacterial content, and constant chemical make-up. With this end in view, a Committee was appointed to investigate the dairies of this class supplying milk to Philadelphia, and to consult with milk producers and veterinarians, as to what should constitute the standards under which a Milk Commission should work.

The report of this Committee, made to the Society in January 1900, embodied the following standards:

Bacteriological. The bacteriologist shall procure a specimen of milk from the dairy, or, preferably, from delivery wagons, at intervals to be arranged by the Commission and the dairy, but in no case at a longer interval than one month. The exact time of the procuring shall be without previous notice to the dairy. He shall test this milk for the number and nature of the bacteria present in it, to the extent which the needs of safe milk demand. He shall also make a microscopic examination of the milk for pus cells. Milk free from pus and injurious germs and having not more than 10,000 germs of any kind or kinds to the cubic centimeter shall be considered up to the required standard of purity.

Chemical. The chemist shall, in similar manner, procure and examine the milk for the percentages of proteids, fat, sugar, mineral matter, and water present. He shall also test its chemical reaction and specific gravity, and shall examine it for the presence of foreign or other matters, or of chemicals added as preservatives. Standard milk shall range from 1029 to 1034 specific gravity, be neutral or very faintly acid in reaction, contain not less than from 3.5 per cent. to 4.5 per cent. proteid, and from 4 per cent. to 5 per cent. sugar, and not less than 3.5 per cent. to 4.5 per cent. fat, and shall be free from all contaminating matter and from all addition of chemical substances or coloring matters. Richness of cream in fat shall be specified, and shall vary not more than 1 per cent. above or below the figure named in selling. Neither milk nor cream shall have been subjected to heat before the examination has been made, nor at any time unless so announced to the consumer.

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[1] Amer. Jour. Med. Sci., 1906, cxxxi, 625.

VETERINARIAN. The Veterinary Inspector shall, at intervals equal to those of the bacteriologist and chemist, and without previous warning to the dairy, inspect the cleanliness of the dairy in general, the care and cleanliness observed in milking, the care of the various utensils employed, the nature and quality of the food used, and all other matters of a hygienic nature bearing upon the health of the cows and the cleanliness of the milk, including also, as far as possible, the inquiry into the health of the employés on their farms. He shall also see that the cows are free from tuberculosis or other disease.

DUTIES OF EXPERTS. The experts shall make their examinations when, and only when, notified to do so by the Commission. Any dairy, the milk of which shall be found by the examiners to be up to the standard of the Commission, shall receive certificates from the Commission.

In case an examination shows the milk not up to the standard, the dairy may have a re-examination made within a week, or within a short time, at the discretion of the Commission.

Milk furnished by the producers to whom certificates have been issued shall be delivered to consumers in glass bottles hermetically sealed in a manner satisfactory to the Commission. In addition to the sealing, and as a guarantee to the consumer that the examination has been regularly conducted, there shall be pasted over the mouth of the jar, or handed to the consumer with every jar, according to the discretion of the Commission, a certificate slip which shall read as follows:

CERTIFICATE OF THE PHILADELPHIA PEDIATRIC SOCIETY'S MILK COMMISSION.

Milk from the dairy of Mr. ....has been recently examined by the experts of the Milk Commission and found to be fully up to the required standards. Another examination is to be made within a month, and, if satisfactory, new labels for the bottles will be issued, dated..................

Notice the dates.

This report was approved by the Society and was adopted as the standard of the Commission. Since its adoption it has been changed in the following particulars:

1. The method originally adopted, for the collection of the samples for examination by the experts, was open to the following objections: It was impossible for either of them to obtain samples from the delivery wagons without previously notifying them to call at their laboratories, and it was equally impossible to secure reliable messengers to carry the milk to them from the delivery stations. At the suggestion of Prof. R. A. Pearson, of Cornell University, then General Manager of the Walker-Gordon Company, it was decided to require the producer, or his agent, to make daily deliveries of samples of milk to the house of the Secretary, thus enabling the Commission to select samples for examination at its discretion. Otherwise the bacteriological requirements remain the same, save that the Commission now certifies to cream, the conditions governing its certification being the same as those for milk, except that it is allowed a bacterial content of 25,000 to the cubic centimeter.

2. The chemist, instead of receiving samples direct from the distributer, examines the samples previously studied by the bacteriologist. The specific gravity of the milk is no longer determined, the acidity of the milk is definitely determined, the allowed variation of the proteid content has been changed to from 3 per cent. to 4 per cent., and the variation in the fat content of the creams has been permitted to vary 2 per cent. on either side of the percentage specified on the bottles. The Commission now certifies to 5 per cent. fat milks, allowing the same variation as in the case of the 4 per cent. milks.

3. The certificates issued to the producers are now placed between the pulp, and tinfoil or paper caps, covering the top of the jar.

These standards, in the experience of the Commission, have proved entirely satisfactory. Some of the dairies which have been under the certification of the Commission since its organization were unable to maintain these standards. These have either been dropped or withdrawn from our certification. Some others, whilst never producing a milk of high bacterial content, have had some difficulty in meeting our requirements, and all have failed occasionally.

The chemical and veterinary requirements have been met more satisfactorily than the bacteriological. There have been practically no failures in the proteid content since the variation of from 3 per cent. to 4 per cent. was determined upon. One of the dairies, producing a 4 per cent. fat milk, had some difficulty for a few months in keeping its milk within the required fat limits. By intelligent shifting of the herd and the introduction of new cows, this obstacle has been definitely overcome.

The Commission feels that it has accomplished even more than it had in mind at the time of its organization. It has not only put at the disposal of the Philadelphia public, milks and creams of a high degree of purity, probably higher than that of any milks and creams produced in the world, but it has stimulated an interest in the pure milk question throughout the country. What is probably of more importance, certainly to Philadelphians, is the fact that it has stimulated the producers and dealers to take greater precautions in the preparation and distribution of milk, thereby elevating the standard of the general milk supply.

There has been an occasional criticism of the rigidity of the standards required by the Commission, and there has recently appeared an article by Dr. A. H. Stewart,[2] which the Commission considers unjust. The article in question is based upon the results of a long series of bacteriological examinations of the various milks receiving the certification of the Commission, together with one milk certified to by the Company producing it and one other which withdraw from the certification of the Commission during the course of these examinations.

Dr. Stewart's article would have been of more practical and scientific value had it contained a definite description of the methods pursued in reaching his results; the manner of production of the media; the temperature at which the plates were incubated; the length of time of the incubation, etc.; a statement of the principle upon which he determines what number of leukocytes in the milk constitutes pus, and especially the exact method by which the inspectors of the Bureau of Health received and conveyed to the laboratories the samples which were examined.

In making his bacterial counts, Dr. Stewart presumably, although he does not so state, made one examination immediately upon the receipt of the samples and another at the end of twenty-four hours. The second examination does not concern the Commission, inasmuch as the keeping of the milk after its delivery is a responsibility which must be assumed by the consumer and is, therefore, beyond the jurisdiction of the Commission. The only comment we need make thereon is that the results obtained would seem to reflect upon the manner in which Dr. Stewart kept the milks which he examined.

As to the manner of collecting the milk we would say that, unless the milk was placed on ice and kept on ice from the time it was accepted from the dealer until the time of the examination, the results of the bacteriological counts would prove unjust to both the producer and dealer. It is the custom of the Commission to have all samples delivered to the house of the Secretary under exactly the same conditions governing the delivery to the ordinary consumer. When the milk is so delivered the responsibility of the producer and the dealer ceases. Recognizing this, all samples are immediately placed upon and kept on ice until the bacteriologist's examination is made, in order to hold the bacterial content, as nearly as possible, the same as at the time of delivery.

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[2] Amer. Jour. Med. Sci., 1906, cxxxi, 625.

Let us now consider the results of Dr. Stewart's bacteriological examinations:

In the case of Dairy No. I (following Dr. Stewart's system of numbering) he made fifty-four examinations between July 18, 1904, and August 24, 1905. Of this number, he condemned 31 (57.4 per cent.), seven for containing pus cells—which means that he considered all samples to contain pus showing a leukocyte count above 100,000 per cubic centimeter; seven for containing streptococci; and twenty-nine for containing bacteria in excess of 10,000 per cubic centimeter—the standard required by the Commission. The samples showing bacteria present in excess of 10,000 per cubic centimeter gave the following counts: 10,200; 10,500; 11,000; 11,300; 11,700; 12,320; 14,600 twice; 16,200; 16,300; 16,500; 18,000; 27,000; 49,700; 72,000; 86,260; 93,000; 94,000; 102,400; 113,000; 117,000; 120,000; 132,750; 150,000; 200,000; 279,000; 390,000; 500,000; 770,000; in other words eleven of these twenty-nine samples contained less than 20,000 bacteria per cubic centimeter and eleven samples over 100,000 per cubic centimeter. In the experience of the Commission, as well as in the results of Dr. Stewart's work, this dairy has made the poorest showing of any of the dairies under the certification of the Commission.

Dairy No II, in Dr. Stewart's series, is the one which has not been under the certification of the Commission since September, 1904, and will therefore not be considered.

Dairy No III had fifty-four samples examined, of which two were condemned for pus cells—(140,000 and 104,000 leukocytes), one for streptococci, and, according to Dr. Stewart's statements, nine times for a bacterial content in excess of 10,000. In his column of results, however, there are but seven counts above 10,000. There is one of 10,000 and the seven others are as follows: 14,000; 15,670; 30,000; 37,500; 50,000; 78,000; 80,500; none above 100,000 and but two above 50,000.

The results of the examination of milk from Dairy No. IV, which Dr. Stewart wrongly states received the certificate of the Commission until June, 1905—the last issuance of certificates to this company having been in January, 1905—will not be considered after the date covered by the last certificates granted it, namely, up to February 10, 1905. This leaves twenty-eight examinations for consideration. In this number, streptococci were found four times, more than 100,000 leukocytes once, and bacteria in excess of 10,000 to the cubic centimeter eight times. Of this number, the counts were 11,250; 14,500; 15,500; 21,130; 24,000; 24,650; 27,400; 730,000. The count on two occasions only was above 25,000 and once only above 100,000.

Fifty-two examinations were made of the milk from Dairy No. V. Of this number, four were condemned for pus cells, none for streptococci, and ten for a bacterial content in excess of 10,000 per cubic centimeter. In these instances the counts were as follows: 10,938; 11,200; 11,600; 12,000; 13,000; 14,800; 28,000; 29,300; 44,000; 77,000. In other words in only four instances was the bacterial content above 25,000 and but once above 50,000.

Fifty-two samples were examined from Dairy No. VI. Pus cells were never found; streptococci were present three times, and bacteria in excess of 10,000 per cubic centimeter nine times. Of this number the counts were 11,000; 11,500; 12,460; 14,300 (twice); 14,400; 15,800; 20,000; 60,000. In only one instance, therefore, was the number of 20,000 exceeded, and that count showed but 60,000 per cubic centimeter.

To sum up the results of these investigations, we find, excluding the results in Dairy No. I, that in 186 examinations the milk contained streptococci five times and exceeded a bacterial content of 10,000—thirty-four times, or in 18.28 per cent. In twenty-two instances the bacteria present numbered 25,000 or less; but three times more than 50,000, and but once more than 100,000; results which must be considered remarkable. Including Dairy I, which was formerly producing the poorest milk of any we certified to, but which is now doing excellent work, the number of examinations made was 240. In this number streptococci were present twelve times and the bacterial content of 10,000 was exceeded sixty-three times or in 16.25 per cent. In thirty-four instances the bacterial count was 25,000 or less, more than 50,000—eighteen times, and above 100,000—twelve times.

It should be observed that the twenty-nine failures of Dairy No. I to meet the bacteriological standard almost equals the combined failures—thirty-four—of the four other dairies, and that the number of instances in which streptococci were found—seven—exceeded by two the number in all of the other dairies. At the time of these examinations, the output of Dairy No. I amounted to less than one-third the total output of all the dairies. Any criticism, therefore, which is based upon the total results obtained from an examination of all the dairies is decidedly unfair to the four dairies making such excellent showings as well as to the Milk Commission.

In reference to what constitutes pus in milk, the views of the bacteriologist of the Milk Commission are not in accord with those of Dr. Stewart. The opinions which Dr. Ravenel holds in regard to this matter have been kindly written for me by him, and they are as follows:

"PUS IN MILK. In taking up the work for the Milk Commission, the bacteriologist realized at once that the question of pus in milk was a most difficult one and the matter was laid before the Commission for discussion, and correspondence entered into with a number of authorities on milk. Leukocytes are practically always found in milk—so much so that we should consider them a normal content, or else hold the anomalous view that all milk comes from udders which are inflamed to a greater or less extent. The pus cell is identical with the leukocyte, and is in fact the leukocyte after leaving the blood. At what point then must we consider leukocytes in the milk as an evidence of disease and call them pus? No standard has been fixed and those who have tried to do so have reached widely varying results, and the methods employed have, with a single exception (Doane), been wofully lacking in scientific accuracy. Dr. Stewart fixes arbitrarily 100,000 per cubic centimeter as an indication of pus, and has condemned many samples of milk on this standard. The normal leukocyte content of the blood in man is about 1,000,000. It is perfectly conceivable that the blood may contain 1,000,000 leukocytes and be healthy, while 100,000 in milk, or some other secretion, may mean pus and inflammation, but to assume this without further proofs than have been brought forward is unscientific, arbitrary, and unjust to the milk producer. It has not been shown by anyone that milk high in leukocytes has any injurious effect, nor has it been shown that their presence means *per se* inflammatory changes in the udder. Certain foods are said to produce a leukocytosis in milk. Induration of the udder can be produced by the injection of sterile water. Leukocytes may be had in enormous numbers in certain fluids by the introduction of sterile substances, as for example aleuronat. It seems perfectly possible that during the process of milking, leukocytes may be squeezed out, so to speak, from the lymph spaces into the milk. It has seemed to the bacteriologist, therefore, that a high leukocyte content should not of itself condemn a milk as containing pus. When it is found in a sample, plates made from the sample are carefully examined for the bacteria generally known to produce inflammation, such as streptococci and staphylococci. The presence of fibrin is also a most useful aid, as pointed out by Doane."

As has been previously remarked, Dr. Stewart does not state by what process he determines the presence of pus in milk, but, in the light of his figures, as Dr. Ravenel has said, one must assume that any milk containing more than 100,000 leukocytes to the cubic centimeter is a pus-containing milk. A number of attempts have been made to establish a standard by which it could be determined what number of leukocytes constitute pus. The earlier methods adopted for this purpose have been shown to be unreliable and up to the present time no standard has been reached.

The most recent, reliable, and comprehensive study that has been made on this subject emanates from the Maryland Agricultural Experimental Station and is presented by Charles F. Doane, referred to by Dr. Ravenel. This author does not consider it desirable to determine the presence of inflammation in the udder by the mere presence of a large number of leukocytes. We quote from his article in order not to misrepresent him and for purposes of clearness, as follows: "The presence of fibrin in pus gives rise to a fairly satisfactory and rapid means of determining the presence of pus in milk. The milk threads catch and retain a large number of leukocytes in a mass. . . . If no fibrin is present, the leukocytes will be distributed singly or at most five or six gathered together. If any quantity of fibrin is present, large numbers of leukocytes, from twenty to one hundred in a single mass, will be seen under the microscope. . . . There can be little doubt that these leukocyte masses or clumps furnish the most practical and easiest means of determining the presence of pus and the healthfulness of milk." As to the number of leukocytes to be found when other conditions suggest the presence of pus, he says: "With these additional means of distinguishing pus, it is interesting to know about how many leukocytes are actually present when milk evidently contains pus. . . . Judging from these and other figures we have of a similar nature, it would appear that milk with a leukocyte count of 500,000 per cubic centimeter is suspicious, when it reaches 1,000,000 per cubic centimeter there is undoubtedly inflammation in the udder."

Therefore, in the light of our lack of knowledge of what should constitute a standard for pus, and in the presence of this statement of Doane's, it seems eminently unfair that anyone should publicly condemn the milk of any dairy for containing pus on the presence of 100,000 leukocytes per cubic centimeter. It is really incomprehensible that one can determine that a milk containing 96,800 leukocytes is free from pus and that a milk containing 100,000 leukocytes is a pus-containing milk.[3] It is interesting to note that in the 297 examinations for pus made by Stewart, in only one instance would any of these milks have been considered to have contained pus on the basis of Doane's figures.

The criticisms which Dr. Stewart makes in concluding his article are as follows: (1) One examination of milk per month is not sufficient; (2) examinations should be made more frequently in the summer than in the winter; (3) examinations for pus and streptococci should be made before the milk is sold; and (4) extra expenses connected with the examinations should be abolished at once.

Answering these in the order in which they were written, I would say that statement No. 1 is incorrect. The minimum number of examinations required by the Commission is one in each month. When there are indications that the working of the dairy or the condition of its products are unsatisfactory, additional examinations are made. The Commission fully recognizes the fact that more frequent examinations would be much more satisfactory to itself as well as to the consumer, but its purpose in making the examinations which may be held at any time during the month, as few as possible, is to reduce the expense to the producer. The only entirely satisfactory method would require a daily examination of the milk, and the expense of such examinations, which must be borne by someone, would scarcely be consented to by the producer and could not be borne by the Commission or the Society which it represents.

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[3] See Stewart's figures. Amer. Jour. Med. Sci., loc. cit.

On the basis of the results obtained by Dr. Stewart, it is questionable if much more could be accomplished by having the examinations made with the same frequency as that adopted by him. Whilst he unquestionably detects failures more frequently than does the Commission, there are a number of instances in which with his frequent examinations he fails to note failures that are recognized by the Commission. The question is one which must be looked at from a practical standpoint and not from the theoretical viewpoint of a laboratory worker. It is an easy matter to sit in a laboratory and make a long series of examinations and evolve a theory therefrom that, if put into operation, might result in the elimination of bacteria in milk. Unfortunately, such theories are of no value. Whatever scheme is adopted for the improvement of the milk supply must take into consideration all of the difficulties under which the producer and dealer work, as well as the expense of the examinations. The purpose of any examination or any standard is to stimulate the producer to adopt the most modern equipment calculated to eliminate the objectionable features of milk production, and to establish a technique in its application as nearly perfect in all its details as is possible and to keep him constantly on the alert in carrying out the minute details of such technique. With the fact constantly before him that he has a definite standard by which his work is measured and that the test of his efficiency (the examination) is liable to be made on any day of the month, is, in the judgment of this Commission, a necessary and sufficient stimulus to good work.

The standard of 10,000 bacteria per cubic centimeter which is only a small part of the standard by which the Commission measures the work of the diary, we do not think, in the light of Dr. Stewart's results or those of our bacteriologist, too high. It is not expected by the Commission that this standard can always be maintained, nor can any useful standard which may be adopted, but we do know that during the most of the time it is, and that the effort on the part of the various producers to reach such a standard, results in the nearly constant production of a good safe milk—a milk so far above the ordinary market milks in point of cleanliness, constancy of its chemical constituents and freedom from pathogenic and all other forms of bacteria, that comparisons are impossible.

As to the necessity of more frequent examinations during the summer than during the winter months, the Commission is at variance with Dr. Stewart—a difference probably explained by the fact that Dr. Stewart made his examinations during two summers and one winter. In the experience of the Commission and in fact on the basis of Dr. Stewart's own figures, the percentage of failures is greater during the months of February, March, and April than during those of June, July, and August, a fact which is probably attributable to the unpreparedness of the dairies for the sudden elevations of temperature which occur at these seasons and to the prevalence of high winds.

Even during these months the Commission does not see that any advantage is to be obtained by increasing the frequency of the examinations, because the examinations which are made detect the failures, and when failures are noted these dairies or their products are kept under supervision long enough to assure the Commission that proper precautions are being adopted to meet the conditions producing the unsatisfactory results.

The recommendation that milk should be examined for pus and streptococci before it is sold is so absurd that it scarcely deserves comment. What does such a proposition involve? In the first place, the milk from an entire herd is never all mixed together. The milk from certain sections of the herd only is mixed, and, therefore, in the product of each dairy there are a number of mixed milks.

If these different mixtures could be kept separate, it would be necessary to have samples from each examined, and even if one sample represented the milk from the entire herd, the inconvenience to the dealer and the expense of employing someone to make such examinations would be too great to place the scheme within the range of possibilities.

The only objection to Dr. Stewart's suggestion that "extra expenses connected with the examinations should be abolished at once," is that he does not suggest the means by which this can be accomplished. It has been the constant purpose of the Commission to reduce the expense to the producer to the lowest point possible, and any suggestion that tends to accomplish this will be gladly welcomed.

In order that the work of its experts—the veterinarian, the bacteriologist, and the chemist—might be of the utmost value, the Commission selected the most eminent men working in these lines to do this work. It is done at the present time at great inconvenience to all of them and at a figure that absolutely fails to compensate them for their services. They happen, all of them, to be men who are deeply interested in the purposes of this Commission, a fact which enabled us to secure their services, and the work that they have done has been most painstaking, conscientious, and valuable. To them more than to any other persons, the Commission owes the measure of success which it has met, and it desires to take this opportunity publicly to express to them its appreciation of their services.

The statement made by Dr. Stewart that "at present there is no one to whom the dairymen can go for either instruction or advice concerning methods, and when trouble comes and the milk is high in bacterial count, he does not know where to locate the trouble," is incorrect. The duty and the practice of the veterinarian is to point out to the producer any deficiencies in his technique and to recommend measures for their correction. Any of the producers will testify to this. In fact one of the dairies and the Commission parted company because the owner objected to the criticisms and recommendations of the Veterinarian. The Commission has always aimed to be helpful to the producers—a statement which we believe will be endorsed by any of those to whose products we certify.

Dr. Stewart is also in error in his statement that most of the certified milk is "stored for twenty-four hours before it is delivered" and that the milk "delivered at the doors in the early morning hours" is usually two days old. None of the milks are stored for twenty-four hours and only part of the product of one dairy is forty-eight hours old when it reaches the consumer, but inasmuch as the product of this dairy—Dairy No III—makes the best showing bacteriologically of any of the milks which Dr. Stewart examined, this fact does not seem to have materially affected its quality.

The truth regarding the deliveries of the various dairies is this: The milk from Dairy I is twenty-four to thirty-six hours old when it reaches the consumer—not two days old, as Dr. Stewart says; the milk from Dairy III is thirty-six to forty-eight hours old; the milk from Dairy V is twenty-four to thirty-six hours old; and that from Dairy VI, twelve to twenty-four hours old. The Commission does not wish to be understood as commending the lateness of these deliveries and refers to the matter solely to correct Dr. Stewart's misstatements, which are unjust to the producer and dealer. The lateness of these deliveries is unfortunately necessitated by inadequate railroad facilities, a condition which the dealers of Philadelphia, as well as the shippers engaged exclusively in the dairy business, have endeavored unsuccessfully to overcome.

We accept with deep feelings of gratitude Dr. Stewart's statement that the Commission's "supervision of dairies has had a most excellent influence, an influence that is being felt in the general milk supply" and in this we believe he is correct, but again we cannot endorse his statement that "the bacterial counts of certified milk are rather disappointing." Our reports are better than his, but we are willing to submit his own figures in evidence.

In closing, the Commission wishes me to add a word regarding the pasteurized milk to which it certifies. At the time the Commission was organized little was known of the bacterial content of pasteurized milks. Pasteurized milks were considered safer than raw milks. The Commission assumed that if the milk which it examined in the raw state was safe from a bacteriological standpoint, it would be safe after pasteurization, and, therefore, decided to certify to it without examination, in order to reduce the cost to the producer. In the light of the examinations of Dr. Stewart and those of Drs. Evans, Pennington, and others, we find that we were mistaken, and we have decided to withdraw our certification of these milks in the future, at least our certification without examination.